SECTION 300 SUBGRADES, SUBBASES AND **BASE COURSES**

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SECTION 301. SUBGRADE PREPARATION

301.01 Description

The preparation of the subgrade for any type of subbase, base and surface course is governed by the specifications in this section.

301.03 General

The final finish of the subgrade must be constructed in accordance with the requirements for the type of base, subbase or surface course being placed. The subgrade shall be compacted to a minimum 95% density and stable to prevent rutting and shoving during construction, provide support for the placement and compaction of paving lifts, limit pavement resilient deflections and rutting of the subgrade during the service life of the pavement. To ensure adequate stability, required minimum levels of strength and stiffness must be achieved in the subgrade soil to a depth determined by both construction traffic and pavement design requirements.

Subgrades may be divided into two different categories. The first is the subgrade constructed on an embankment. The second is the subgrade that is constructed in a cut section or very near the existing ground surface. A stable subgrade can be constructed by controlling moisture and density as the embankment is constructed. However, the stability of a subgrade in a cut or on or very near the existing ground surface is greatly affected by the insitu soil conditions.

An exposed cut section should be examined as soon as possible. This is important in order to determine whether or not conditions in the exposed cut are those predicted on the basis of the preliminary soil survey. Since even the most thorough soil survey gives information only at point locations, often separated by considerable distances, careful examination of the roadway will assist in locating problem foundation materials or faulty drainage conditions which must be corrected. Corrective action may be required for foundation materials which are exceedingly weak, those which appear to be much weaker than originally thought, and materials which differ significantly from adjacent material with respect to frost susceptibility. If the inspection reveals excessive seepage into the cut, problems of instability, often including frost action, may result in future rapid deterioration of the pavement and/or slopes unless special corrective measures are taken.

The stability of an earth subgrade is critical for the construction of subsequent pavement lifts and the future performance of the pavement structure. The Resident should make a careful inspection and evaluation of the entire subgrade for stability prior to placement of the subbase or base course.

The stability of the subgrade can easily be evaluated by inspecting the amount of deflection and/or rutting which takes place under the wheels of heavy construction equipment. The *Subgrade Stability Manual* provides requirements for subgrade stability and outlines the following remedial procedures for unstable subgrades:

- 1. undercut and backfill
- 2. lime treatment
- 3. moisture density control

It is not always apparent which remedial procedure should be used for a particular situation. The Resident responsible for the subgrade should make the District Soils Engineer aware of

any subgrade stability problems so s/he can evaluate the condition and make the appropriate recommendation for corrective action.

301.05 Aggregate Surface Course, Type B

Although no rolling is required, the provisions of Article 301.03 apply and the subgrade must be approved by the Engineer before the surfacing material is placed.

301.06 Bituminous Concrete Base Course and Pavement (Full-Depth) and Portland Cement Concrete Base Course and Pavement

The subgrade shall be compacted with a pneumatic-tired roller, three-wheel or tandem roller. In small street returns and tapers, hand tamping may be necessary due to the limited space. Close inspection is important where mechanical equipment is not used.

Preparing Subgrade Ahead. When the subgrade operation gets too close to the paving operation, there is a tendency to overlook some details in the subgrade preparation in an effort to get ahead. This may result in poor workmanship or neglect of important features of the work. Therefore, the preparation of the subgrade shall be ahead of the paving operation by one day's paving production rate.

Moisture Content. When concrete surface or base courses are to be constructed, the subgrade shall be in a moist condition to prevent moisture from being drawn from the concrete. It may become necessary to re-wet the subgrade by sprinkling

Checking Subgrade Planer (or Subgrade Machine). The cutting blades on the subgrade planer (or subgrade machine) should be checked and set to cut the subgrade to the required depth and crown. It is the responsibility of the Contractor to set the equipment to obtain the required crown and thickness and to keep it properly adjusted.

Subgrade or Subbase Template. All finished subgrades or subbases shall be checked for crown and proper elevation prior to starting paving. Electronically-controlled subgrade machines may be used as the template for slipform or form paving or the heavy subgrade template with forms.

301.08 Drainage

A stable subgrade is essential and it can be secured only if adequate attention is given to surface drainage. Water pockets create soft or spongy spots in the subgrade or make it muddy or otherwise unfit to receive the surfacing material. The Contractor shall make provisions for surface drainage.

SECTION 302. LIME MODIFIED SOILS

302.01 Description

Used to prepare a working platform in conjunction with the mechanistic pavement design for the subsequent pavement structure. It is also used as a construction expedient.

302.04 General

Prior to Lime Modification, the soil should be brought to approximate final grade. This will help assure a uniform thickness of stabilization following final trimming.

SECTION 310. LIME STABILIZED SOIL MIXTURE

310.01 Description

As a subbase layer, the lime treated soil is a part of the pavement structure, and thus must provide permanent improvement to the treated soil.

SECTION 312. STABILIZED SUBBASE

312.01 Description

This work consists of furnishing, placing and compacting a Bituminous Aggregate Mixture (BAM), Cement Aggregate Mixture (CAM), Pozzolanic Aggregate Mixture (PAM), or a Cement Aggregate Mixture (CAM II) on a prepared subgrade.

312.02 General

No stabilized subbase should be constructed that cannot be surfaced during the current construction season. The reason for this requirement is that stabilized subbases and the respective subgrades upon which they are placed tend to deteriorate when left exposed to the elements over the winter months.

Refer to the Stabilized Subbase, BAM, CAM, PAM & CAM II checklist for requirements of the various types of subbase.

SECTION 351. AGGREGATE BASE COURSE

351.01 Description

Aggregate Base Course is generally used as a foundation for flexible surfaces. Ensure that the crown and superelevation have been constructed as shown on the plans.

351.02 Materials

You should inspect the aggregate as it is delivered and placed. Watch for foreign substances such as chunks of wood, weeds and particularly clay balls and lumps of dirt. Be sure the material has been inspected and approved. If you have any doubts as to the quality of the material that is being delivered or find that segregation is quite prominent, consult your supervisor.

351.05 Base Course

A. The Contractor should begin the aggregate placing operations with lifts that will not be greater than 100 mm (4 in) when compacted. Generally, a loose measurement of about 150 mm (6 in) will result in a compacted thickness of 100 mm (4 in). If tests show that the specified density is obtained, the compacted thickness may be increased to 200 mm (8 in).

The spreader must be capable of placing the aggregate the full width of one lane and to the desired thickness for one lift. Do not permit the aggregate to be deposited in excessive

thicknesses in one lane with the top half of the material then bladed to the adjacent lane. The Specifications require a minimum of blading and manipulation. If blading and manipulation is necessary to achieve proper crown you should make sure there is sufficient moisture present in the material to prevent segregation.

B. Type A. Visit the plant and inspect the mixing operation. Assure yourself that the water and aggregate are being mixed to provide a uniformly moist product. Material that is either too dry or too wet will not compact well when rolled.

It is possible to get density (but not stability) at a moisture content higher or lower than optimum. The Inspector should be aware of appropriate ranges from optimum s/he should be trying to achieve. In case the material was deposited on the subgrade or prior lift of base, and the desired density was not obtained, the aggregate can be aerated or wet down in place so as to obtain required density of 100 percent. This is only for those isolated cases when material was inadvertently placed in a too wet or too dry condition. It must not become an accepted part of the normal operation.

Inspect the rolling operation. For best results, the roller should follow as closely behind the spreader as possible. If you find that the base is pumping, cracking or is showing other signs of failure, determine the magnitude of the failure. It may be something easily corrected. If not, discuss the difficulty with your supervisor. Placing multiple lifts without proper cure time on the previous lift(s) could be the source of the problem.

C. Type B. Water for Type B Base Course may be added after aggregate has been placed on the grade. You will have more difficulty obtaining uniform moisture content by this method than by the pug mill method; however, close inspection throughout the operation will help provide the desired product.

There is no numerical density requirement for Type B Base Course. The compaction is to the satisfaction of the Resident.

351.06 Tolerance in Thickness

Obtaining the thickness shown on the plans depends primarily on the inspection control you exercise. Anything less than 90 percent of plan thickness is not permitted. Excess thickness is permitted except as limited by the 108 percent maximum for the tonnage pay item.

351.11 Method of Measurement

The method of measurement will determine your inspection and quantity control procedures and ultimately the documentation you will need to substantiate payment for this item.

If the unit of measurement is the metric ton (ton), the aggregate must be weighed on scales approved annually by the Department of Agriculture. A weight ticket must accompany each load of material delivered to the job from the quarry, pit, or stockpile. A copy of the ticket must be given to the Inspector, who must initial the ticket for purposes of documentation.

The Resident should review the Documentation Section of this Manual for additional information.

SECTION 352. SOIL-CEMENT BASE COURSE

352.01 Description

The Soil-Cement Base Course is generally used as a foundation for a bituminous surface. The construction of a Soil-Cement Base Course consists of processing soil, cement and water either mixed in place on the roadbed or by a traveling mixing plant.

352.09 Dry Mixing

When using multiple base mixing equipment, the soil and cement should be satisfactorily mixed prior to the addition of water. Once the dry mixing process has started, all operations through the compaction of the mixture should be continuous without interruption.

352.10 Moist Mixing

- A. With equipment other than a traveling mix plant. Processing the soil-cement mixture with a multiple pass mixer may require the addition of water in several increments in order to provide the optimum moisture required for mixing and compaction. The Specifications limit the range of moisture content for various soils used in the soil-cement mixture and should be followed to obtain a satisfactory result.
- B. With a traveling mix plant. A traveling mixing plant is so designed that the addition of water and the mixing of soil, cement and water are obtained in one pass of the equipment. If proper mixing is not obtained in one pass, the forward speed of the machine should be reduced to improve the mixing.

352.11 Compaction and Finishing

Compaction of the soil-cement mixture is a continuation of the moisture mixing operation and should be conducted uninterrupted after moist mixing is completed. It is important that the edges of the Soil-Cement Base Course be compacted as well as the remaining portions of the base course to prevent failures along the edges.

352.12 Protection and Cover

The Soil-Cement Base Course, after being finished, is provided with a protective cover of bituminous material to protect against loss of moisture or abrasion by traffic during the 7 day curing period. Any damage to the protective coat by construction equipment or other traffic is to be corrected by the Contractor.

If the air temperature is expected to reach the freezing point during the curing period, straw should be used to protect against freezing.

SECTION 353. PORTLAND CEMENT CONCRETE BASE COURSE

353.03 Equipment

Prior to starting the placing of any concrete, be sure the required equipment is available and in good working condition. It should be checked to be sure the plan cross section of the pavement can be obtained. The finishing machine should be carefully checked to be sure the screed is adjustable and will go in and out of superelevation accurately and give the desired pavement slope at all times. You should also insist a subgrade template be available and used

continuously ahead of the paving train to be assured that the proper thickness of the pavement will be attained.

353.11 Surface Test

Usually, Portland Concrete Cement Base Course is overlaid with a bituminous material. In order to obtain reasonable control of the quantities specified for the bituminous material and a satisfactory finish, you should insist that the concrete base course be placed to the plan grade. Periodic inspection on your part will be necessary to be sure the required results are being obtained.

SECTION 354. PORTLAND CEMENT CONCRETE BASE COURSE WIDENING

354.04 General

During excavation care should be taken to avoid damaging the existing edge of pavement. The existing edge of pavement should be carefully checked to ensure that the edge is clean of all loose material before rolling and checking of the subgrade for the required thickness.

354.05 Subgrade

After the subgrade has been excavated it should be checked with a stringline or a template to be sure the specified thickness can be obtained. The subgrade should not be disturbed during the paving operation.

354.06 Constructing Without Forms

It is important that the consistency be as uniform as possible so the edges will not slump with the movement of the equipment.

354.07 Constructing With Forms

Prior to placing the paving forms, the grades should be checked to be sure that proper slope of the base course widening is being attained. A form line should be smooth and the forms inspected before the concrete is placed.

354.09 Tolerance in Thickness

After the forms have been properly graded and set, the subgrade should be checked with a stringline or template so the plan thickness of the paving course will be obtained. Before and after cross sections are still required for base course thickness determinations when using a template.

SECTION 356. BITUMINOUS CONCRETE BASE COURSE WIDENING

356.05 Subgrade

Prior to starting any placing of bituminous material, the subgrade should be rolled and the widening depth checked with a stringline or template to verify that the necessary depth will be obtained.

356.06 Base Course Widening

The existing edge of pavement should be carefully checked to ensure that the edge is clean of all loose material before rolling and checking of the subgrade for the required thickness. It is necessary to keep traffic off the newly-completed widening until it has cooled sufficiently to support traffic.